

Innovations in Technology Enhanced Learning

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Edited by

Anton Ravindran and Liz Bacon

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P U B L I S H I N G

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STEERING INNOVATION, SERVING SOCIETY

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PREFACE

With the unabating acceleration of change, both in technology and knowledge transfer, it is clear that individuals and corporations have only one option: either continue to learn, unlearn and relearn or permit our skills sets and knowledge to become redundant and obsolete as the shelf life of knowledge erodes fast. Enterprises that fail to cultivate and support an environment for continuous learning by their employees will quickly lose their competitiveness in the global market place and slide into oblivion. Thus technology-based learning and education is becoming increasingly important in the 21st century.

Indeed, until recently, all teaching methodologies developed for students up to their tertiary education were largely based on traditional delivery models. However, a significant amount of research has now been done on the best ways to teach adults as well as how to leverage the best from technology to deliver such training. Corporations are constantly on the lookout for more cost effective, as well as standardized and convenient ways to deliver training to their employees in a self-paced manner. Online learning models including MOOCs, are radically changing both the delivery model as well as the learning experience. This book consists of a collation of selected innovative research findings, which were further developed into book chapters focusing on technology based training and education.

Undoubtedly, online learning has significantly increased learning options and has introduced new dimensions for education and training. The key factor that differentiates traditional education from online education is its inherent flexibility and global reach as it is not confined to traditional classrooms but enables learning from anywhere and at any time. It is an attractive proposition given the increasing need for lifelong learning. Online education presents participants with an opportunity for global connection and interaction and discussion in a ubiquitous real time manner. While earlier versions of computer-based training and education were focused on individualized learning, with the advances in technology, today's online education is more focused on various types of interaction and collaboration by the participants, thus enriching the learning experience. This is comparable to the dialogue that would take place in a

classroom environment during traditional delivery, but has the potential to allow contributions from around the globe.

Although there has been long debated discussions that learning online is different from learning in a traditional classroom, it is neither better nor worse pedagogically but rather an alternate model to complement the traditional learning environments to meet growing need and demand for lifelong training and education. Online technologies will continue to significantly transform the way that such learning takes place

This book, written by 24 authors contains 12 comprehensive chapters under 4 broad themes: Socialisation; Technology Acceptance; Adaptive, Adaptable, Personalised & Engaging Environments and Metacognition and Monitored Environments. We have presented research findings from 10 countries in 4 continents. The book covers major issues about technology based learning, provides ample resources on diverse aspects of online education technologies and gives unique insights about online education. We hope the contents of the book will help to widen the perspectives and better equip academics, education and training professionals and practitioners alike with a more advanced vision of online education.

Dr. Anton Ravindran

FOREWORD

This book consists of a collection of state-of-the-art research papers discussing innovations in the area of technology enhanced learning in adult education. It was inspired by ideas presented at the annual Computer Science Education: Innovation and Technology conferences, organised and administered by Global Science and Technology Forum (GSTF), at which Professor Liz Bacon has been a regular speaker. Input for the twelve chapters have been sourced from ten geographically dispersed countries from across the world: USA, Spain, Portugal, UK, Bahrain, Saudi Arabia, Malaysia, Singapore, Iran and Australia, providing a truly international perspective on the field. With rapid developments in the technology and delivery mechanisms including the development of MOOCs (Massive Open Online Courses), online learning is in the process of revolutionising higher education, which makes this book all the more relevant and timely.

The intended audience for this book are academics, university students, particularly PhD students, researchers and industry professionals working in this area. However, it may also be relevant to learners interested in developing their online learning skills. It provides an illuminating insight for anyone interested in this domain, in particular the way in which the nature and practice of education is being transformed across the globe. This transformation is impacting every level of education, both formal and informal, and throughout life.

Chapter 1 introduces the author's views on this subject, discussing the worldwide demand for technology enhanced learning now and in the future. It reviews 4 key areas, identified in research literature and through research undertaken by the authors, as the key to the success of online learning, these being: metacognition and learning strategies; engaging and immersive environments; socialisation; and adaptive, adaptable and personalised environments, all of which are expanded upon in the other chapters of this book. The chapter then moves on to discuss the need to develop metacognitive students who are able to cope with the more flexible and open nature of online learning in higher education, which many students struggle with, discussing the need for higher education to take a more andragogic / heutagogic approach to teaching. This approach also opens up opportunities to free up the learning process by enabling students to develop their skills in a monitored and authenticated digital

learning environment. Such an environment would also enable students to develop an active portfolio and CV, and support the move toward assessment when ready as opposed to assessment at fixed scheduled times.

In addition to the themes picked up from chapter 1, another theme which emerges across the work described in the rest of the book is on evaluation, or rather technology acceptance, as it is described in the models. This addresses the rationale for the continued use of learning technologies by students. The subsequent chapters in the book are organised relevant to these 4 broad themes, although the research described in some chapters will contribute to more than one theme. The chapters themselves and their thematic relationships are briefly described below:

Theme 1: Socialisation

The first theme is that of socialisation. Chapter 2 explores the need to adapt our traditional ways of teaching for delivery in online learning environments and investigates the development of communities of learners in different types of teaching and learning environments. Conclusions from the research emphasise the need for students to become not only more independent, but collaborative and social learners in an online learning environment. It also discusses the challenges this brings for students who are traditionally unfamiliar with this type of learning and the need for the role of the teacher to change in order to become both a facilitator and co-learner with the students. Chapter 3 provides a comprehensive literature review of social media-enabled learning and associated environments in higher education. It examines the design methodologies that move higher education from a focus on content provision to a dynamic, open, flexible, collaborative and learner-centred approach. It then discusses the development of knowledge creation and understanding, and the need to develop the collective intelligence of students through social interaction. Chapter 4 provides a perspective from Malaysia where the use of social networks in e-learning tends to be less well used in education than in many other parts of the world. The study, based on the Push-Pull Mooring framework, investigates factors that influence the use of social networks in e-learning. In this research, the Push- Pull-Mooring framework was used to identify the factors that push people towards e-learning (perhaps reluctantly), the pull factors that attract people towards e-learning and the mooring factors which encourage delay in movement. Results revealed e-learning Perception, Ease of Use, Convenience, Academic Reasons and Social Networking as key factors in

determining the use of social networks in e-learning. Chapter 5 continues the social networking theme with an examination of the use of Facebook in an educational setting and its impact on Iranian student life given its use is currently prohibited. The chapter discusses the reasons why students use social networking sites, and in particular Facebook. The student survey undertaken focuses on establishing the reasons why students adopt a technology (based on the Technology Acceptance Model - TAM) and the impact of their personality on their use of social networking sites.

Theme 2: Technology Acceptance

Chapter 6 describes a study, based on male students studying English as a Foreign Language in a college in Saudi Arabia, which focuses on determining whether voluntary or mandatory use of an e-learning management system (LMS) affects adoption of that technology. The questions in the study are based on the Technology Acceptance Model (TAM) and it focuses on answering the research question “what are the factors that impact the adoption of an e-learning system in voluntary and mandatory settings?”. Chapter 7 presents the literature on technology acceptance models and discusses how e-learning has been adopted in the Spanish and Portuguese Higher Education Systems, focusing on the adoption of e-learning, in the form of blended and mobile learning. Results of the analysis and examples from two institutions, one in Spain and one in Portugal, have both concluded that one of the biggest challenges faced by higher education institutions in moving forward with e-learning is the need to train and motivate teachers, and their subsequent willingness to integrate new approaches into their teaching.

Theme 3: Adaptive, Adaptable, Personalised and Engaging Environments

Chapter 8 discusses the results of a study carried out at an Australian university to establish if cultural and language differences affect students’ online interactions and communications. The study used a modified Online Learning Environment Survey (OLES) to collect data from undergraduate students from 14 countries: studying a range of disciplines including Health, Law, Education, Science & Technology, Creative Industries, Business, Built Environment & Engineering. This chapter analyses the differences between the cultures, their expectations, and their motivation for online learning, arguing the need to provide adaptable and personalised systems that support the needs of international students based on their

culture, and also to recognise the support required for lecturers to provide this personalisation. Chapter 9 describes the development and use of a platform to support students in learning how to program computers and can support several programming languages. In some modes of the platform, the students can use a drag 'n' drop interface akin to puzzle games to help them develop their code. As the students work their way through a set of programming problems, they unlock videos which provide additional information, encouragement, and motivation. All modes provide a personalised and engaging learning experience supporting the development of students at their own pace. The platform is used by the author to hold weekly programming tournaments at the start of a class to support a combination of competition, personalised learning and peer-supported learning. This approach has been shown to motivate students to come well-prepared to class, in addition to providing the teacher with a wealth of information about how the knowledge and skills of their students are developing. Chapter 10 describes the challenges of reading electronic documents for the vision impaired. Although standards have been developed for the markup of electronic documents, many online documents do not provide this and readers consequently encounter unstructured text and scanned documents which require optical character recognition in order to determine their content. This approach includes the additional challenges and complexities of reading multi-dimensional material such as mathematical formulae which can contain subscripts and superscripts etc. The author describes the development of a personalised Complete Reading System designed to be portable, low powered, simple to use, standalone and affordable, which has been designed to address the identified challenges, and is specifically aimed at use in developing countries.

Theme 4: Metacognition and Monitored Environments

As touched on in the description of chapter 2 above, this theme develops one of the key success areas identified in chapter 1 for online learning, that of metacognition, discussing the need to develop metacognitive learners. This theme is further explored in chapter 11 which picks up on another discussion initiated in chapter 1, that of monitoring, supporting and capturing the student experience in digital environments. This chapter describes the development of JULI, a Java Ultra- Lightweight Interpreter for use in teaching introductory programming, a topic that traditionally has high failure rates for first year computer science students. JULI is an environment that provides personalised guidance on errors to students and its use by students in Australia has resulted in a marked

improvement in their success rates. The JULI environment provides an analysis of error logs which helps the author discover common errors and mistakes made by students, thus providing him with insight into student learning and enabling him to develop enhancements to JULI to further support student learning and metacognitive development. Finally, chapter 12 describes a technology enhanced learning environment used at a medical university in Bahrain with the aim of both supporting the learner with inspiring content to help them learn non-core curricula, and also to provide a monitoring tool for the lecturers, and a facility to control access to content in order to help students organise their learning and develop their metacognitive skills. As identified in some previous chapters, despite being digital natives, students do not automatically know how to develop and manage their learning online; in other words students cannot automatically be assumed to be metacognitive. In this study, the Microsoft Learning Content Development System (LCDS) was used to help create inspiring customised content by providing templates to develop games, quizzes etc. A particular focus of the work is on Test Yourself Activities, in addition to the use of a checklist, which helped staff to monitor student engagement and progress through the module.

Conclusion

This book provides a truly international and cutting edge perspective on developments in technology enhanced learning. Supporting higher education students in the move towards maturity in their learning, sufficient to cope with the typical flexibility, open nature and choices provided by technology enhanced learning, is not trivial and their ability to thrive in such an environment will be greatly impacted by their metacognitive development. Similarly, as several chapters in this book identify, the move towards technology enhanced learning is fundamentally dependent on motivated and skilled teachers developing and supporting learning materials and assessments for students. In order for both teachers and learners to be successful in the online world, it is important that they understand those factors which will impact on their success. For teachers, this is in the ability to develop effective and engaging learning materials for delivery in online environments and to provide relevant engagement and support to their students. For learners, they are subject to the same factors that they would experience in traditional face-to-face learning such as personal issues, motivation, personality traits etc., but they also need to be mature enough as learners, i.e. metacognitive, to be able to cope with the demands of a purely online service. For many of those involved in

higher education, a common belief is that online provision is a poor second compared to face-to-face interaction between teachers and students, and this inevitably impacts the acceptance and take up of online facilities. However, online learning developed and supported by committed, motivated and skilled teachers for students with good levels of metacognitive skills, can offer a rich, flexible, individual learning experience that can exceed that offered in traditional face-to-face environments. The global requirement for higher education is growing at such a rate that online learning currently offers the only viable solution to meeting the needs of vast numbers of learners. These online services need to be managed across a wide range of delivery mechanisms, from simple mobile devices to advanced computing facilities. The combination of many of the technologies described in this book, together with the skills, motivation and enthusiasm of online teachers, and the support for the range of delivery mechanisms, must all come together to ensure that the provision offered to those learners gives them the best possible learning experience.

We hope that this book will encourage you to become involved in online and technology enhanced learning, whether as a teacher, a learner or in some other capacity. The technologies described within these chapters will become redundant as technology evolves swiftly and novelty, more alluring, but the learning models and human issues will remain relevant and important for the foreseeable future, and must be addressed if we are to successfully provide support for the next generation of online learners.

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DEVELOPING NEXT GENERATION ONLINE LEARNING SYSTEMS TO SUPPORT HIGH QUALITY GLOBAL HIGHER EDUCATION PROVISION

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Abstract

The world's demand for higher education, particularly in the developing world, is increasing. However, demand is often not co-located with supply and most students cannot afford to study abroad. In the short term this demand can only realistically be met through online distance learning provision. However, currently online distance learning students face many challenges in completing their courses and success rates are often poor. This chapter reviews the factors affecting the success rates of online distance delivery from both the student and education provider perspectives. The results of this analysis identify four factors that the literature has shown to be key to success in online learning, all of which the authors have been researching for the past decade. This analysis is followed by a discussion of their research contribution in these areas, set in the context of the literature. It is then argued that a primary goal of higher education, and one that is key to the success of online learning, is to produce students who are metacognitive and able to develop their skills into lifelong learning and that, in order to do this, the educational model needs to move towards a more andragogic/heutagogic approach. In doing so, this could provide opportunities to free up the learning process by enabling students to develop their skills in a monitored and authenticated digital learning environment, providing students with an active portfolio of achievement and CV, supporting the move toward assessment when ready as opposed to assessment when scheduled.

Keywords: Metacognition, games-based learning, adaptable, adaptive, personalised learning, socialisation, learning strategies.

1. Introduction

The world we now live in is predominantly governed by the growing and ubiquitous digital technologies that allow us to communicate, carry out our business, develop Government structures, be entertained, network with colleagues, family and friends and, to a large extent, live our lives. For years we have been driven by Moore's law (Moore 1965) and, as a result, all the advances that we have seen in hardware and software have been promoted on the basis of technological arguments such as greater speed, greater functionality, more power and more storage. However, in the last few years we have seen the move begin from technology drivers, focused on developers and technologists, to design drivers focused on end users. It can be argued that the arrival of new technology such as netbooks and the iPad (Apple) represent design models utilising existing technology in ways that more readily fit the needs of users, while new technologies such as Wii (Nintendo) represent attempts to produce technologies that fit more readily with the lifestyle choices of users. This fundamental shift away from technology drivers to design drivers associated with the ubiquity and pervasiveness of computing technology within society not only changes the way that users think about the technology, but must also impact on the way teaching and learning can, or should, occur utilising that same technology.

Current models of higher education in the UK, and across the world, are predominantly based around traditional lecture and tutorial models, with assessment by submitted and marked coursework and exams, supporting a pedagogic model developed in the nineteenth century. Even subjects that one would anticipate to have moved away from this approach to embrace modern technological approaches, such as Computer Science, still predominantly maintain this model. As tools and technologies have developed to support Technology Enhanced Learning (TEL), we have not seen a commensurate development of twenty-first century teaching models and practices, and much of the existing TEL development has focused on repeating existing pedagogical models and practices. Attempts to introduce new large-scale models, such as MOOCs, suffer from significant non-completion rates, and therefore do not currently provide a viable alternative to traditional face-to-face teaching or online distance learning approaches. However, there is a significant and rapidly growing requirement for higher education provision in developing countries, which

already far outstrips the ability of those countries to respond by increasing traditional provision. It has been argued that the ubiquity of computing and telecommunications technology should permit the existing higher education providers in developed countries to meet this need through online distance provision, but this really requires the development of new teaching models and practices.

The authors have been jointly researching in this area for over a decade, and have identified four key factors that should be addressed in developing new teaching models and practices to ensure successful technology enhanced learning, whether undertaken at a distance or in support of face-to-face provision. This chapter provides a general background to the issues of TEL, using this to identify and clarify the key factors to be addressed. It then discusses each of the four key factors, which are: metacognition and learning strategies; engaging and immersive learning environments; socialisation; and adaptive, adaptable and personalised environments. This is then followed by a consideration of the major research context and our own research, to give a clear rationale for the key nature of each factor and how it can be addressed in new teaching models, providing examples of successful research outcomes that demonstrate the potential benefits for students in each of these areas. The final section of the chapter reflects on one of the key objectives of higher education: the desire to develop metacognitive students so that they can successfully continue their lifelong learning once they leave formal education. In order to achieve this, the educational model needs to become more andragogic or heutagogic in nature to ensure that students develop the skills to direct and manage their own learning, a skill even more essential today if students are to benefit from online distance learning. Finally, with the move to more learning taking place in digital environments, it is argued that these environments should provide the capability to identify the user, monitor their learning, provide an authenticated portfolio of achievement and CV and support the move toward assessment of individuals when they are ready as opposed to requiring knowledge and skills to be demonstrated at specific points in time, scheduled typically at the convenience of the awarding institution.

2. Why teaching students face-to-face has to change

Whilst there are pockets of good practice around the sector in terms of the use of technology to support teaching, the vast majority of teaching, particularly in STEM subjects, is delivered using a very traditional lecture based model of face-to-face teaching alongside examinations that are

relatively traditional in their form. Our students are expected to attend classes in the manner of school pupils who attend to receive instruction. The educational models that we currently use tend to be primarily didactic and pedagogic, focused around the idea of telling the student what they need to know in a teacher-pupil or parent-child relationship. We have developed timetables, class module structures, teaching models and delivery mechanisms which fundamentally support an instructivist, didactic, pedagogical model of learning. However, we also expect students to take responsibility for their own learning and think for themselves in the manner of adults and emerge from this process as adults, who are meta-cognitive and have a constructed view of reality which permits them to manage their own learning and development. There are undoubtedly subject areas where this style of teaching is appropriate and relevant. For example, in teaching a fire drill there is no value in a philosophical discussion about the nature of fire from first principles, since what we wish to achieve is an operant conditioning that results in our subjects unthinkingly establishing a pattern of behaviour relative to a stimulus, i.e. they vacate the building upon hearing a fire alarm without question or debate. However, for the majority of Higher Education teaching, such an approach would be completely inappropriate.

An obvious point that could be argued here is that there is nothing wrong with the status quo. We have evolved and changed and perhaps the world is unfolding as it should. You only have to look at the growth of VLEs, eLearning technologies, distance learning systems and virtualisation to see that progress is being made. However, although all of this is true, we do need to be sure that what we are doing represents a move to an educational model that maximises the potential of technology to support learning, and is not just a case of using the technology as an alternative means of delivery. When we first started using VLEs, the most prevalent viewpoint was undoubtedly that this was simply a way of delivering material to students, and the majority of the early adopters simply loaded their existing materials, in whatever form they had them, on to the new system and the term “shovelware” (Khoo et al. 2010) was coined. Clearly we have moved on, and there are undoubtedly academics who have developed their practice in the use of VLEs, prepare their materials as learning objects, use well-formed eAssessment instruments and utilise modern multimedia and social networking technologies to support student learning, but these are still few and far between. It is still the case that the majority of academics prepare materials in relatively traditional ways, and make limited concessions to the new technologies in the way that they develop and design their materials. For example, lab

classes still tend to be run on the basis of textual instructions to carry out tasks utilising the relevant technologies, rather than through software walkthroughs, vodcast instructions or remote control experimentation, e.g. network simulation or physical control of a robot.

This situation is not going to diminish in the future and we are already in the situation where those who study, particularly in subject areas like computer science, do so almost entirely within digital environments but, as discussed above, we still teach predominantly according to traditional models. In the example of computer science we therefore find ourselves in the situation of teaching a subject area fundamental to the development of the twenty-first century, changing the very nature of how we live our lives, and yet seeking to do so using a nineteenth century educational model. What is therefore immediately apparent is that we have to change and we have to change now, because our students are already living and working differently from the mechanisms we seek to impose on them. They arrive at university having been fully immersed in a digital world and in many instances their understanding of the technologies far exceeds that of their instructors. These are important issues for the future development of higher education, not just in computer science but across all subject areas, as the technology makes it possible to completely revise the educational model. Higher education must utilise twenty-first century techniques, appropriately supported by technology, in order to create efficient, effective, personalised teaching for students that develops truly metacognitive adult learners.

3. The worldwide demand for higher education and the need for online distance delivery

The current world population is approximately seven billion people. The United Nations is predicting that by 2100 there will be 11 billion people on the planet (United Nations 2011), despite the fact that birth rates have decreased since 1990 (the peak birth rate for any year in the worlds history). Regardless of whether the population increases or decreases, throughout the world the demand for higher education is likely to continue to increase as more people choose to study to that level than ever before (Dorling 2013). In the western world, the percentage seeking to study in higher education is relatively stable or growing slowly, despite there being a political will to increase numbers in many countries. Western higher education institutions are generally mature, and funded to cope with this demand. This is not true of the developing world. Although many

countries have some outstanding universities, in-country capacity is often unable to meet the demand for higher education which has massively increased in recent times; that is to say that demand far outstrips supply in the developing world, which cannot build sufficient universities to cope with this demand in the short term. For example India, which is home to a third of the world's poorest, education can make a huge difference and the country therefore has ambitions to increase those in higher education by 10 million in the next five years, from the 25.9 million currently in higher education. Their target by 2016/17 is to educate over 25% of 18 to 23 year olds. By comparison, in 2011/12 only 17.9% of the target demographic entered higher education (Times Higher Education 2013). Growing higher education provision by 40% over five years is a challenge by any standards, and most developing countries have similar ambitions. Given this scenario there is a need to investigate and develop alternative models of higher education, for both the developed and developing worlds, to help meet this huge demand.

Potential students are no longer constrained by geography. Increasing wealth in the developing world is enabling more students to study abroad than ever before. However, for those that can't afford it, internet access is providing access to higher education in a way that was not possible in the past. Considerable research has been undertaken to support the development of technology enhanced learning (TEL) for both distance and face-to-face students. However, a big change is that online distance education can now offer a route to provide high quality educational resources from the developed world to learners in developing countries locally and at an affordable cost. As a result of this increasing demand for higher education and availability of supply alternatives, higher education providers need to compete for students at the global, as well as national and local levels. The result is that the sector has to substantially rethink its model of the delivery of higher education, and this has already begun in a significant way, for example with the introduction of MOOCs (Massive Open Online Courses). Online education is not only designed for those studying at a geographical distance from their lecturers; it has become an important part of higher education and its role is increasing, with many students now taking an online course as part of their studies. In the US in 2010, 30% of students took an online course at some point during their college career and the trend is increasing (Hachey et al. 2012).

The success rates of online courses can, however, vary tremendously and have been shown to be particularly poor for MOOCs, the success rate of which is often at less than 10%. There are a variety of factors affecting the success of online course delivery and research studies have often

reported inconsistent findings. However, the following factors have been shown to affect success rates from the student perspective:

1. Prior experience of online courses
2. Age
3. Gender
4. Ethnicity
5. Motivation
6. Intrinsic interest in the subject
7. Personal and financial issues
8. Learning styles and learning strategies
9. Social and cultural characteristics including an ability to make friends online
10. Metacognition

From the perspective of the education provider, offering the following facilities to students have all been shown by research to support the learning process:

11. Engaging and immersive learning environments
12. Provision of adaptive interfaces and personalisation of the environment including the learning materials
13. Ability to support students in forming social groups for mutual support and collaborative learning
14. Retention of some physical contact with other staff and students, i.e. mode of delivery being more blended learning than completely online at a distance.

It is not possible to address the first seven factors within the teaching environment, which is our focus here (though some can be addressed within the support environment). With regard to 1, it has been shown that success rates of online distance courses are influenced by familiarity and prior experience with online environments. This will increase over time; however the students arrive at the start of a course with whatever experience they have and this can't be changed overnight. In terms of 14, this is about physical contact with other staff and students, and our focus here is about the nature of the online aspects of delivery, regardless of whether or not they are supported by face-to-face contact.

This leaves us with six factors, which we have been investigating through our research for a number of years. With regard to learning styles and learning strategies, we believe from our research that learning

strategies have a far greater influence on student performance than learning styles, which are not without problems. There has been considerable debate in the literature with regard to the use, definition and approaches to determining learning styles, over several decades. There is no universally agreed definition of learning styles, but two that reflect a general view are Brusilovsky and Millán (2007) who define learning styles as “the way people prefer to learn” and Dunn et al. (1989) who define learning styles as “a biologically and developmentally imposed set of personal characteristics that make the same teaching method effective for some and ineffective for others”. Despite the disagreements, the majority of learning styles research agrees there is a distinction between visual, auditory and kinesthetic learners, and some research, including our own, has successfully incorporated their use into a variety of eLearning systems, for example Graf and Kinshuk (2007), Cemal Nat et al. (2009) and Peter et al. (2011). That said, we will not focus on them in this chapter for several reasons: they are not in wide use today and the functionality offered is considered inflexible, and there is a body of research that suggests the basic premise of the research, theories, findings and implications for teaching using learning styles is flawed, as learning is a significantly more complex process than can be expressed by learning styles. Some argue that it is the learning preferences of students that are being measured, not their learning styles, and question the objective measurement of the self-reporting subjective judgements students make about themselves. Whilst learning styles might have their use and place, we do not see them as playing a significant role in online learning in the future and will therefore focus our discussion on the remaining success factors as identified above. The discussion about learning strategies will be included with metacognition, which is where we believe they truly exist. We also believe the two socialisation factors identified above from the student and education provider perspectives can safely be combined. Therefore, to summarise, the four key areas we intend to focus on are:

1. Metacognition and learning strategies
2. Engaging and immersive learning environments
3. Socialisation
4. Adaptive, adaptable and personalised environments

The following section of this chapter reviews these four key areas, including our own work in this space, and demonstrates why we believe it is essential to address these areas to provide and support successful and effective online learning.

4. Review of Key Success Factors in online learning

As outlined above, the four key areas upon which we focus – metacognition and learning strategies; engaging and immersive environments; socialisation; and adaptive, adaptable and personalised environments – have been shown to contribute to student success in online learning environments. This section discusses the literature and our research in these areas.

4.1 Metacognition

In this context metacognition is defined as the knowledge someone has about how they personally learn. This includes strategies about when and how to use particular learning techniques, including how to make selections between learning objects and materials, i.e. someone's "learning strategy". In face-to-face education this is not something that is generally taught; it is somehow expected to emerge as students' progress through their education and, by the time they reach higher education, it is assumed that students are generally metacognitive. It is likely that those who are will fare better. Although it is generally expected that this understanding just emerges over time, for many learners it does not, but most still manage to make it to the finish line when participating in traditional modes of face-to-face teaching. In common with face-to-face teaching, online distance education typically does nothing more to help the students develop their metacognitive skills, and often this type of learning can accentuate problems that arise when students lack such skills. Traditional classroom learning is what students are most familiar with and have experienced all their life so most students develop learning strategies to cope with that approach. In online learning students can be confronted with an unfamiliar style and often a choice of learning materials, typically represented as text, graphics, animation, audio and video. These are commonly presented in a nonlinear way (Azevedo, Cromley and Seibert 2004; Mulwa et al. 2010), which is a model that is unfamiliar to them. As a result, this requires students to take more control over their learning, as it provides/requires a more heutagogic, as opposed to pedagogic/andragogic, model of learning and therefore works best for students who are motivated, self-directed, well-organised and strategic. However, if they are not metacognitive, then they will typically flounder more than in a traditional classroom setting as they not only have to understand how they learn, but they must maintain more self-management and self-discipline in their learning to ensure they remain motivated to finish the course. The

generally lower success rates for online distance learning courses are reflective of the fact that many students find this a significant challenge and need the regular discipline of attending class to help maintain motivation. With online education, where more self-discipline and self-managed learning is required, development of metacognition for online students is more important than ever. High quality students will generally always succeed regardless of how they are taught. However, for weaker students it is far less likely with current practice that we will get them to the level of independent metacognition that we desire, and this is a failing in our practice.

In the tradition of humanities and the classics, the teaching of rhetoric and reasoning focused on the ability of the student to understand the process of learning, but to some extent in modern higher education this tradition has diminished over time. In science and engineering the basis of learning has tended to be much more ontological, with epistemology reserved for proof modelling to demonstrate the correctness of ontological facts or to add to the body of knowledge. However, in more recent times we have seen a renewed emphasis on the consideration of intellectual reasoning as a component of higher education. For example, in computer science considerable activity has focused on the concepts of computational thinking (Wing 2006). It can reasonably be argued that computational thinking, like rhetoric and reasoning before it, is about helping students to understand how to organise their thinking relative to a particular approach to learning, in this case computational problem solving. Perhaps the most important point is that this once again enables us to reflect on the metacognitive skills of students as they apply reasoning approaches to the learning tasks they undertake. Some of our recent work (Kazimoglu et al. 2012) has produced empirical evidence of the impact of a computational intelligence approach in learning technical skills and knowledge in computer science, and this lends weight to the argument that supporting the development of metacognitive skills is one of the key factors for student success in developing learning systems. Within the consideration of reasoning approaches such as computational thinking we also see many of the elements of social constructivism, particularly the idea of learners constructing their own world view of a subject area, learning being a social activity, and the role of the tutor as a guide rather than the font of all wisdom.

The literature has shown a number of ways that metacognition can be developed and supported. A few key examples of these are:

- The need for a well-designed learning environment (Kirsh 2005). A good visual design that provides an appropriate structure, well-written easy to understand sentences which require less cognitive effort to comprehend, ensuring that links to learning materials and support tools, such as chat tools, are easily visible to students and are not missed, can all make a significant difference to the effectiveness of metacognitive development.
- That not all students have the ability to manage and regulate their learning, and deploy relevant strategies at the right time, monitor their own progress etc. (Azevedo and Cromley 2004). In order to be successful, students need to be aware of their own thought processes and be able to monitor the effectiveness of their learning strategies in order to develop the ability to self-regulate (Zimmerman 2008). This ability to undertake self-regulated learning is a form of metacognition and also includes the ability to translate knowledge, skills and attitudes from one learning environment to another (Boekaerts, 1999). The presence of a tutor in a technology enhanced environment has also been shown to assist with the development of metacognition (Azevedo and Cromley 2004).
- That the educational psychology literature has also questioned whether individual metacognitive abilities are as a result of biological differences or different learning experiences, i.e. nature vs nurture (Woolfolk and Margetts, 2007). In terms of biological differences, the research on this is unclear. However, several researchers have demonstrated that metacognitive skills training and support for self-development can help (Wagster et al. 2007; Gunter et al. 2003), in addition to the fact that students develop metacognitive abilities as part of their usual learning and observation experiences (McInerney and McInerney 2006).

Some of our recent research work in this area has focused on determining the impact of student metacognitive skills by assessing a student's recall and retention of information within a formally designed and technology enhanced learning environment (Cemal Nat 2012). In this research, a group of students were provided with a range of learning materials in different formats – e.g. text, audio and video – and were allowed a choice of what materials they used to learn a specific topic. Prior to starting the experiment students were asked to answer a questionnaire, based on the Felder and Silverman Learning Style Model (FSLSM) to determine their learning style. The learning outcomes were assessed using a recall-type assessment test immediately after the students

completed the learning. This was followed up with a retention test that took place two weeks later. The performance of the students who studied using materials consistent with their learning style (matched group) were compared to those who did not (mismatched group) in order to determine which group performed better. Some analysis of external factors that might have affected the learning, such as prior knowledge of the subject, were assessed and taken on board in drawing conclusions from this study. Key findings from the experiment were as follows:

- The results that show statistically significant achievements in learning performance were associated with both the matched and mismatched groups. The matched group that performed better showed evidence of an effective use of metacognitive skills in that they found a route through to be successful.
- Where the mismatched group performed better, there was evidence of the students applying appropriate learning strategies and thus demonstrating metacognitive abilities. In addition, the findings regarding student ability to use or develop effective metacognitive skills in the event of a mismatch between their needs and the learning environment, can be used to guide educationalists in building learning environments that encourage students to learn how to learn.
- This experiment represented the first attempt to establish a relationship between metacognition and FLSM; however what it did show was that learning styles were not a good arbiter to use for designing TEL environments. It did however generate some evidence for the use of cognitive strategies and demonstrated the importance of metacognition in the student selection of learning materials. It also defined a methodological approach to design a TEL environment that could be used to help students to develop metacognitive skills and, thereby, cognitive strategy.
- Experimental data collected through the TEL environment showed the learning behaviours of students, thus it is possible to determine the learning strategies of students. For example, the skills and strategies that students in the mismatched group used may help other students to develop their learning strategies. Therefore, advice can be provided to students on the basis of what works for them, by using this experimental model with different course materials. In addition, individual feedback can be given to those who do not perform well by analysing their learning behaviours.

4.2 Engaging and Immersive Environments

In a face-to-face classroom learning environment a good teacher will engage students in the subject, find ways to explain concepts differently to students on the fly when confronted with struggling students, and reinforce/repeat key points throughout a teaching session as appropriate. Outside of lectures, teachers can engage in a one to one dialogue easily, and adapt their explanation and the support they provide to an individual. However, one of the key drawbacks of the massification of higher education in developed countries has been the depersonalisation of the learning experience for students at all levels. Clearly it is not possible for an individual classroom teacher to provide a personalised experience for every one of the 20 to 30 primary or secondary school pupils in their class and it becomes even less likely in higher education where lecturers are often faced with classes of 200-plus students. With online environments, given the tutor is at a distance, it is considerably harder to inspire students with standard learning materials and provide personalised tutoring by the teacher. However, online learning has the potential to provide a different range of learning experiences that could not be provided by a teacher in a classroom. For example, areas that have been shown to be very successful in engaging students and improving learning are the use of rich multimedia environments, immersive simulation environments, and the use of games.

It can be argued that games offer the ideal medium for TEL because they are inherently constructivist, engaging and immersive. Games have formed a basis for educational activities for centuries, and gamers return to play them because they provide fun and enjoyable experiences. The social nature of games is also well understood, providing opportunities for educational cohort effects such as peer bonding, expert-novice tutoring and vicarious learning. They also provide personalised experiences with players taking their own individual routes through a game, receiving feedback as they progress. Games by their very nature, since players will rarely be successful on their first attempt at a game, provide opportunities for repetition (a key aspect of learning), reinforcing and building on concepts learned earlier in the game. Games alone cannot, and should not, be used to teach all aspects of all subjects. They can however form a significant, novel and important part of higher education and can be used to support, engage and retain online distance learners in an immersive manner that is not available to classroom teachers. Rich multimedia environments, in particular serious games, offer opportunities to develop realistic immersive games and computer-based simulations which provide

fun and engaging learning environments. Much of the serious games industry has grown up around the concept of “Serious Games for Serious Training” (Chan 2007) with applications being developed for a range of situations from military and security, through health and education (Graven and MacKinnon 2008), all the way to politics (Ochalla 2007).

Recent research by the authors in this area has utilised games and multimedia, augmented reality, and simulation environments. Three recent projects are briefly described:

4.2.1 Maritime City

Maritime City (Flynn et al. 2010; MacKinnon et al. 2012) is a tool currently being used to train Social Workers using an immersive, serious game. The need for this game stems from the requirements to meet a set of UK Social Work standards for practice in order to qualify. Whilst all students should have a placement during their education in order to gain practical experience of dealing with real world scenarios, a placement cannot guarantee to provide a full range of experiences that a student should encounter by the time they graduate. Traditionally role-play activities are used to fill the gap. However the quality of these can be variable as they depend on the acting abilities of the students, their enthusiasm to engage etc. Due to the immersive and engaging nature of games, it was decided to develop a game-based training environment that could be used instead of, or in addition to, role-play activities. The game environment presents the player, who takes on the role of the Social Worker, with a virtual city, as shown in figure 1, and various scenarios are presented to the player in which they have to make decisions about actions to take in their capacity as a Social Worker.

In the first scenario (see figure 2) the Social Worker is confronted with a challenging child-abuse case, which is based on a real case in the UK, where the child ultimately died. The player has to make decisions about how to deal with difficult and abusive parents and, given there are two children involved, which one to focus their immediate attention on etc. A particularly important aspect of the game was the need to convey facial characteristics and body language as Social Workers must be able to develop not only their skills to interpret both verbal and non-verbal forms of communication, but a non-judgemental, objective view of client emotions. Whilst an avatar clearly does not look as real as a human, research has shown that avatars can elicit an emotional response similar to that of a real human face (Mosera et al. 2007) and therefore, coupled with the voice of professional actors, it was felt this approach could be effective.



Figure 1 – Maritime City



Figure 2 – Screenshots from Scenario 1 of parents and abused child in Maritime City

In terms of the evaluation, the first version of the first scenario was tested with ten qualified Social Workers (not trainees) who were undertaking a Masters degree at the University of Greenwich in London. They completed the game and then undertook some role-play, both related to the same scenario. Their feedback was gathered through a combination of a survey, using a Likert-scale, and open-ended responses to questions. Overall the results were extremely positive. 37.5% found the game “very realistic” and over 62.5% found the game easy to use and good at communicating the lessons to be learned. In terms of realism, in the initial version the characters were thought to be a bit too “clean”. However, the students found the game compelling and engaging, and the emotions displayed by the avatars consistent with the voices of the professional actors.

4.2.2 The Pandora Project

Pandora was an EU FP7 Project (Bacon et al. 2012; MacKinnon et al. 2013) that was completed in March 2012. The software and associated training environment that was developed is now being further developed and deployed by our eCentre research group at the University of Greenwich, as part of the Pandora commercial training toolset. The purpose of Pandora is to train Gold (strategic level) Commanders in crisis management through an augmented reality, immersive environment designed to use emotional affect in order to impact decision-making. Gold Commanders in the UK are senior individuals with executive responsibility, who are required to take responsibility and make strategic decisions about their organisations' services and facilities in the event of a crisis. Example organisations are likely to include Fire, Police and Ambulance Services, and Local Authorities. In the event of a crisis, these individuals would be expected to work together to provide strategic solutions to an unfolding crisis. Example crises could be a plane crash, a health pandemic, an emergency caused by extreme weather, or a combination of these. However, they are all crises that require solution by more than one agency. During a crisis, Gold Commanders are typically co-located in a room and not at the scene of the emergency. They will give instructions and direction to others who will find on-the-ground solutions to implement the strategy. Gold Commanders have a number of priorities to take on board in setting the direction such as protecting their own staff whilst containing the emergency, relieving suffering, protecting people and property, ensuring that the supply of critical services continues or is restored if already lost. They will also be involved in the evaluation of a crisis in order to identify lessons learned once the crisis has been brought under control.

Traditionally Gold Commanders are trained in the following two ways: either through table-top, mostly paper-based exercises or through real simulation exercises. In table-top exercises, for the most part the participants have to imagine the events in the scenario that are being described to them on paper or verbally by an instructor which, no matter how enthusiastic all participants are, the instructor included, leaves it very challenging to experience the stress and emotional engagement that would naturally occur in a real crisis situation. With regard to a real simulation exercise, whilst these provide the realism of a genuine crisis situation, they are very expensive to organise and run and realistically can only simulate a few events from a crisis scenario, with a limited set of outcomes.